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The Impact of Two-Tier Producer and Consumer Food Pricing in India

Maurice Schiff

Previous studies have claimed that two-tier producer and consumer food pricing policies lead to higher average farm prices. In fact, the impact on prices is negative in the more realistic cases. In India such a policy, designed to help the urban poor, probably hurt the farm sector as a whole, although it probably helped the rural poor in the short run.

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Summary findings

India's government procures agricultural products such as rice, wheat, and sugar at below-market prices and sells them in both urban and rural ration shops. The rest of such crops is sold in the open market. This creates a two-tier price system for consumers and producers.

Many (including Dantwala, Mellor, and Hayami, Subbarao, and Otsuka) claim that such a policy raises the open-market price so much that it ultimately increases the average price received by farmers. If true, the gainers would be the farm sector as a whole and low-income urban consumers with access to the ration shops. Losers would be the high-income urban consumers who buy at the open-market price. This view has provided an intellectual basis for the policy.

Schiff examines a variety of cases: with and without rationing, with rationing by ration cards or by queuing, with and without the urban rich having access to the ration shops, with and without free trade, and with a marketable surplus with positive, negative, or zero price elasticity.

He finds that in most cases the policy's impact on the average price is either negative or ambiguous, and it is negative in the more realistic cases. A negative impact implies that farmers on the whole lose from the procurement policy.

But small farmers who are net buyers of the procured crops, and landless laborers, gain from a lower average price in the short run (especially if they have easy access to the rural ration shops). The long-run effect depends on the impact of the lower average price on rural employment and wages.

This paper — a product of the Trade Policy Division, Policy Research Department — is part of a larger effort in the department to examine the impact of agricultural policy on resource allocation and distribution. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Sheila Fallon, room N10-025, extension 38009 (32 pages). December 1993.

THE IMPACT OF TWO-TIER PRODUCER AND CONSUMER FOOD PRICING IN INDIA

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I. Introduction

Governments generally discriminate against agriculture in developing countries.1/ Export crops are taxed in order to transfer resources to the rest of the economy and food crops are often taxed to provide cheaper food to the urban consumers.2/ Several countries have instituted a procurement policy in order to attain the latter objective.

Through their forced procurement policy, these countries procure food commodities from producers at below-market prices and sell them to low-income consumers through their ration shops. The governments thus impose a producer levy on the output they procure. Producers may supply additional demand at any price the market will bear. This policy results in a two-tier price system for producers and consumers. In the case of India, wheat (rice) procurement in the Punjab has averaged about 50 percent (from 60 to 80 percent) of output since the late 1960

India's food procurement policy applies essentially to wheat, rice and sugar. Procurement is carried out at the local market in the case of wheat and at the mill in the case of rice and sugar. In the case of wheat, the government has closed surplus states following droughts in order to depress the procurement price. Imports were increased in time of droughts in the 1970s. This was less so in the 1980s when large stocks had been accumulated.3/

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1. On the impact of sectoral, fiscal and industrial policies on agricultural incentives in Africa, Asia, Latin America and Mediterranean countries, see Schiff and Valdés (1992).

2. However, Schiff and Valdés report that when food is imported, most LDCs tax the imports and protect the producers. In those cases, the cheap food motive is dominated by the self-sufficiency and revenue motives.

3. A brief review of India's procurement and distribution system is provided in Subbarao (1992). Also, Gulati's 1987 study deals exclusively with India's procurement and distribution policies.

Wheat farmers in India's surplus states have recently refused to sell their output to the government procurement agencies. The boycott was intensified after a call by the India Farmers Union to boycott the procurement agencies in protest against low procurement prices and severe restrictions on the selling of wheat to other states. ("The Times of India", May 8, 1992, and "The Economic Times", May 7, 1992.) On the other hand, Dantwala (1967), Mellor (1968) and more recently, Dantwala (1981) and Hayami, Subbarao and Otsuka (1982) have argued that farmers do not suffer from the procurement policy. They claim that, since procurement leads to an increase in the open market price, the average of the procurement price and the open market price is no less than the price farmers would have obtained in the absence of procurement. In fact, Hayami, Subbarao and Otsuka formally model markets with government procurement and conclude that procurement policy leads to an increase in the average price received by farmers both in the short and in the long run.4/ That conclusion is in contradiction with the behavior of wheat farmers who resisted selling their output to the procurement agencies.

Production is assumed to take place in a competitive industry. Thus, farmers cannot on their own achieve price discrimination between various consumer groups in order to increase their profits. The question is whether the public procurement and distribution policy can result in a price discrimination scheme which actually raises farm profits. Dantwala, Mellor, and Hayami, Subbarao and Otsuka argue that farm profits unambiguously increase. We argue that the latter occurs only under somewhat questionable assumptions (no rationing and no access by the rich to the ration shops) coupled with restrictive conditions (that the policy only be applied infinitesimally, or alternatively that

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4. We believe there are several limitations to Hayami, Subbarao and Otsuka's analysis. For instance, they describe the policy as entailing queues by the urban poor to obtain the rations at the fair price shops (p. 655) but their model includes no cost of waiting and assumes no rationing (p. 656). Second, they state that the access to the ration shops is general (p. 655) but their model assumes market segmentation with the access restricted to the poor (p. 656).

parameters of the demand functions be restricted to specific values which are not supported by the evidence). We show that under reasonable assumptions producers will suffer from the policy.

This issue was examined in Schiff (1992) for two cases involving rationing, a positive price elasticity of marketable surplus, a closed economy, and alternatively with or without market segmentation between rich and poor. In this paper, we examine the issue under more general conditions. For instance, trade liberalization in agricultural products is presently being discussed by the government of India (and has been carried out to a large extent in a number of other developing countries). Hence, the free trade case is examined here. The conditions under which we analyze the impact of the procurement and distribution policy are: with and without market segmentation between urban rich and poor, with and without rationing, with rationing by ration cards or by queuing, under free trade and for a closed economy, for a positive, zero or negative price elasticity of marketable surplus, and for the short run and long run. These conditions were not all considered in previous analyses. The results are summarized in Table 1.5/

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5. We do not consider the case where the procurement price is higher than the market price and acts as a price floor (which has happened in some bumper crop years). We also abstract from the impact of the policy on price variability. Note that Hayami, Subbarao and Otsuka find that procurement policy increases the likelihood of market price instability.

II. Model

Preliminary Issues

Before proceeding to a full analysis of the various cases, we examine four issues.

1. Let us first consider the issue of urban market segmentation. Subbarao (1992), writing about the excessive cost and ineffectiveness of India's Public Distribution System (PDS), claims that no serious efforts were made to limit access to the PDS to only the most vulnerable groups. In fact, all urban consumers are issued ration cards (which are even used for identification). Hence, the urban rich have access to the ration shops. If they do not consume the product which is procured because of its poor quality (or because of the inconvenient location of the ration shop), we only have to consider the urban poor's demand for the procured product.

If farmers can adjust the quality of their products so as to sell a lower quality at the ration shops, then the gain to the poor of having access to the ration shops will fall, and so will the cost to the farmers. At the limit, if farmers are able to costlessly adjust quality to the lower ration-shop price, then farm profits remain unchanged. And if low-income consumers are indifferent between better quality at the higher price (in the absence of procurement policy) and lower quality at the lower price, then consumer welfare remains unchanged. In that case, the policy is totally ineffective. In reality, adjustment of quality to price will entail a cost and will result in a partial reduction in the policy's effectiveness.

The same is true with evasion. If it can be done costlessly, the policy will be ineffective. If it entails a rising marginal cost, evasion will occur up to a point and will reduce the effectiveness of the policy. Authorities have closed some surplus states at times of drought to inter-state trade in order to limit evasion. We abstract from these two issues in the remainder of the paper to keep the problem manageable and to enable a comparison with the findings of others, but the above qualifications should be kept in mind.

If the urban rich do consume products which are procured and have equal access to the ration shops, the question remains as to whether they will choose to buy at the fair price shops if queues are present. The value of time of the urban rich is higher than that of the urban poor, so that their full cost of buying at the fair price shops, inclusive of the value of their time, might be larger than the open market price. However, the urban rich typically use the urban poor (e.g., a servant) to stand in line for them and can thus obtain the procured output at the same cost as the urban poor. This is particularly true in the case of India. In our analysis, we consider both the case of perfect urban market segmentation between rich and poor and of no market segmentation.

2. The marketable surplus M equals output S minus rural demand D_F, or:

(1) $M = S(P) - D_F(P,\pi)$,

where P = price received by farmers and π = farmers' profits. Then:

(2) $$\frac{dM}{dP} = \frac{dS}{dP} - \frac{dD_F}{dP} = \frac{dS}{dP} - \left[\frac{\delta D_F}{\delta P} + \frac{\delta D_F}{\delta \pi}\cdot\frac{\delta \pi}{\delta P}\right] = \frac{dS}{dP} - \left[\frac{\delta D_F}{\delta P} + \frac{\delta D_F}{\delta \pi} S\right],$$

since, by Hotelling's lemma, $\frac{\delta \pi}{\delta P} = S$.

Assuming the good to be normal, the effect $\frac{\delta D_F}{\delta \pi} S$ of an increase in P is positive, and it is possible that $\frac{dD_F}{dP} > 0$. It is even possible that $\frac{dM}{dP} < 0$ if $\frac{\delta D_F}{\delta \pi} S > \frac{dS}{dP} - \frac{\delta D_F}{\delta P}$. 6/

Krishna reports for subsistence crops in India values for d(logM)/d(logS) of 1.04 and 1.06, implying dM/dP > 0. Most studies on developing countries also obtain positive values for dM/dP.

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6. For small farmers for whom $M \leq 0$, $\frac{dM}{dP} > 0$.

$$\frac{dD_F}{dP} = \frac{\delta D_F}{\delta P} + \frac{\delta D_F}{\delta \pi} S = \left[\frac{\delta D_F}{\delta P}\Big|_U - \frac{\delta D_F}{\delta \pi} D_F\right] + \frac{\delta D_F}{\delta \pi} S, \text{ or: } \frac{dD_F}{dP} = \frac{\delta D_F}{\delta P}\Big|_U + \frac{\delta D_F}{\delta \pi} M.$$

The first term on the R.H.S. is the substitution effect and is negative. Thus, if

$$M \leq 0, \frac{dD_F}{dP} < 0 \text{ and } \frac{dM}{dP} > 0.$$

We consider here the cases of $\frac{dM}{dP} < 0$, $\frac{dM}{dP} = 0$ and $\frac{dM}{dP} > 0$, but assume that the price elasticity of marketable surplus is larger than the price elasticity of urban demand to insure that the equilibrium is both unique and stable.

3. If we assume that the procured amount is not sufficient to satisfy the demand at the below-market price and that it is rationed through ration cards, then those who have access to the procured output benefit from an intramarginal income gain, and the relevant price (at the margin) for them (as well as for those who have no access to the rationed output) is the market price. This point is important for the formulation of the demand functions in Cases 3 and 4 below.

We also examine the case of rationing by queuing. Supplies at the ration shops may not be sufficient to satisfy the rationed demand. This is relevant in a number of Indian states. For instance, Subbarao (1992) claims that in Andhra Pradesh where coverage is wide, the PDS met only 34 percent of the minimum rice requirements of the poorest. For all grains, 2.5 million tons were required to fill the ration quotas of the poorest but the State Government provided only 1.7 million tons, and some of it went to other groups. On the other hand, the states of Gujarat, Kerala and Tamil Nadu have been quite successful in targeting the poor. Thus, our analysis in the absence of queuing may be more relevant for those states. However, the situation is worse in some other states (Bihar, Rajasthan, Madhya and Uttar Pradesh). The latter account for a large share of India's poor but receive only a small share of PDS supplies. This has resulted in long queues. Hence, the analysis in the presence of queues is relevant for these other states.

4. Authorities set a procurement price P_0 which is below the market price P_m. Procurement is generally carried out at the trader/processor level and is proportional to the marketable surplus which is sold by the farmer to the trader or processor. The price farmers receive is then a weighted average $\bar{P}$ of the procurement price P_0 and the open-market price P_m. $\bar{P}$ is also the marginal incentive

since procurement is proportional.7/ Then, output S, marketed surplus M and rural demand D_R are all a function of $\bar{P}$ and not of P_m. This assumes that all farmers have a positive marketed surplus.

The distribution of gains and losses by farm size has been examined by Sah and Srinivasan. The formal model abstracts from farm size and landless laborers, but these issues are examined in each case below. Small farmers might have a negative marketed surplus, i.e., they might be net buyers, and so would the landless laborers. The relevant price at the margin would then be the open market price or the procurement price, depending on which market the small farmer or landless laborer would have access to. If purchases in the rural areas are made in the same proportion as in the urban areas, then the relevant price is also P-BAR.

If the procurement policy depresses the average price P-BAR, then producers as a whole lose. However, in the short run, small farmers who are net buyers and landless laborers gain. And they especially gain if they have access to the ration shops in a proportion which is larger than in the urban areas, i.e., if they pay less than the average price P-BAR. To be net buyers, small farmers must earn extra income and be employed on other (larger) farms or must work in the non-farm rural sector. Rural employment opportunities are generally related to agricultural incentives. A lower average producer price will depress rural employment opportunities. Hence, the long-term impact on small farmers and landless laborers of a procurement policy which results in a lower average price depends on the impact of the policy on rural employment and wages.

The analysis is carried out in a partial equilibrium framework. For simplicity, the model abstracts from administrative costs and marketing margins. This does not affect the results as long as these costs are the same for the private and public sector. This assumption biases the results in favor of those obtained by Hayami, Subbarao and Otsuka since public sector costs are likely to be larger than private sector costs. The implication of differential costs is discussed in the concluding section.

If the authorities subsidize the operation either in terms of transport costs or by providing low consumer prices (paying farmers for procured output more than they charge consumers at ration shops), then the average farm price will be larger than the average consumer price. In those cases, farmers as a whole and consumers will benefit more from the policy compared to a case of no

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7. If a fixed amount were procured in each farm, the marginal incentive would be the open market price P_m.

subsidies. In this paper, we assume that the procurement and distribution policy is self-financed. In other words, no budgetary resources are used to provide explicit consumer subsidies. This enables us to compare our results with those of others (e.g., Hayami et al.).

Farmers typically produce more than one product. It is precisely because of the existing substitution possibilities with other farm products that the supply curve in equation (1) has a positive slope. We assume here that there are no distortions in the other product markets so that we can focus exclusively on the impact of procurement and distribution policies on the product in question. That also enables us to compare our results with those of others.

We assume that there are three sets of demand, D_U^R of the urban rich, D_U^P of the urban poor and rural demand D_F, and that the procured output is only distributed in the urban areas. We also assume that output depends on current price and abstract from dynamic considerations due to production lags or storage.

Case 1. Free Trade

The procurement policy has generally been examined in a closed-economy setting. The issue of extending the process of industrial trade liberalization to the agricultural sector in India is part of the current policy debate. Such a process has already taken place in a number of developing countries. In the case of free trade in the product in question, and under the small-country assumption, the analysis is simple. The market price P_m is independent of the procurement policy. Therefore, the average price $\bar{P}$ in the case of procurement is lower than the market price in the absence of procurement, since in the former case part of the crop is procured at a price $P_0 < P_m$.

Thus, farmers as a whole lose. In the short-run, though, small farmers who are net buyers and landless laborers gain, while in the long run, the impact is ambiguous, depending on the effect on rural employment and wages. Those urban consumers who have access to the procured output gain.

No consumers lose. These results hold both in the short run (output S given) and in the long run, with or without rationing, and with or without market segmentation between urban rich and poor. However, in the case of rationing by queuing, arbitrage may lead to a length of queue such that the cost (inclusive of time) will be P_m in both markets. (The reason for that is discussed below in Case 3). Then, no consumers gain.

We can state

Proposition 1. Under free trade and the small-country assumption, procurement has no impact on the open-market price P_m, the average price $\bar{P}$ falls, farmers as a whole lose (though small farmers and landless laborers gain in the short run), no consumers lose and those with access to the procured output gain. However, if procured output is rationed by queuing, consumers may not gain.

In the case of drought and managed trade, the open market price P_m rises and governments have often closed the surplus states (to prevent them from exporting to the deficit states) in order to keep the procurement price P_0 low and be able to purchase the quantity needed. Governments have also often allowed larger imports in response to droughts when stocks were low or have sold stocks when they were large. Thus, when the procurement policy has been applied most intensely is precisely when supply has been most responsive (through imports or reduction in stocks) and the market has thus tended to be more open. And, as we have seen above, under these circumstances, the impact of such a policy is more likely to be a fall in the average producer price $\bar{P}$.

The analysis above assumes that the law of one price prevails. However, we know that there is a gap between the FOB and CIF price at the port (say Bombay in the case of wheat) and even more so in the interior (say the Punjab). Pursell and Gulati (1993) have estimated these margins for 1985-87. In the case of rice (wheat), they were equal to 5 (17) percent at the port and 25 (43) percent in

the main surplus area (Punjab). Thus, even under free trade, the products might behave as non-tradables within a certain price range. Then, the open-market price might be able to increase with procurement and the effect on the average price would be ambiguous. This is less likely to happen at ports where the price range is smaller (five percent for rice in Bombay) than in more distant locations.

We proceed with the analysis under the assumption of a closed economy for the product analyzed. Our results also hold for the case where international trade in that product is managed by the government and is independent of the procurement policy.

Case 2. Closed Economy and No Rationing

In the case of no rationing, there must be market segmentation between rich and poor. Otherwise, all consumers can buy at P_0, resulting in excess demand which will have to be rationed.8/ Thus, the poor have unlimited access to the procured output at price P_0 and the rich can only buy in the open market at price P_m.

Market equilibrium is given by:

$$(3) \qquad M = S(\bar{P}) - D_F[\bar{P}, \pi(\bar{P})] = D_U^P(P_0, Y^P) + D_U^R(P_m, Y^R),$$

where

$\bar{P} = qP_0 + (1-q)P_m$ is the average price received by farmers on their marketed surplus M,

q = proportion of marketed surplus which is procured = D_U^P/M in the case of no rationing, P_0 = procurement price, P_m = open market price, S = output, D_F = rural demand, D_U^j

8. A possible exception is the case where the price elasticity of the marketable surplus is so negative that at the lower producer price P_0 farmers release for urban consumption exactly the increase in urban demand or more. However, this raises problems of multiple equilibria and stability. As was mentioned earlier, we assume here that the price elasticity of marketable surplus is larger than the price elasticity of urban demand to insure that the equilibrium is unique and stable. Then, market segmentation must hold in the case of no rationing.

= urban demand by group j, j = P (poor), R (rich), Y^j = income of urban group j, and π = rural profits.

We examine the impact of a change in P_0 on P_m and $\bar{P}$. The derivation is presented in Appendix A. The solution is given by equations A.3, A.5 and A.6. The sign of $\frac{d\bar{P}}{dP_0}$ is ambiguous (see equation A.6). Since $\frac{d\bar{P}}{dP_0} \gtrless 0$, it follows from (A.5) that $\frac{dq}{dP_0} \gtrless 0$, and it then follows from (A.3) that $\frac{dP_m}{dP_0} \gtrless 0$. Thus, it is not even possible in this case to know the effect on the open market price of a change in the procurement price. These results hold both in the very short run (output given) and in the long run.

However, if $dM/d\bar{P} = 0$, then $dP_m/dP_0 < 0$ (P_m rises as P_o is reduced) but the sign of $d\bar{P}/dP_0$ remains ambiguous. In that case, the urban rich are worse off since they buy only at P_m, while the urban poor (who can satisfy their entire demand at the low P_0) are better off. The effect on the producers is ambiguous.

If we start from a situation of no procurement policy ($P_0 = P_m$), we show under plausible assumptions that if $\frac{dM}{d\bar{P}} \geq 0$, then $\frac{dP_m}{dP_0} < 0$ and $\frac{d\bar{P}}{dP_0} < 0$, i.e., in that case a "small" application of the procurement policy leads to an increase in the open market price and in the average price received by farmers. We set $P_m - P_0 = 0$ in (A.6). Then

$$\frac{d\bar{P}}{dP_0} = \frac{(1-q)\frac{dD_U^P}{dP_0} - q\frac{dD_U^R}{dP_m}}{(1-q)\frac{dM}{d\bar{P}} - \frac{dD_U^R}{dP_m}} = \frac{A'}{B'}$$

and from (A.3)

$$\frac{dP_m}{dP_0} = \frac{\frac{dD_U^P}{dP_0} - q\frac{dM}{d\bar{P}}}{B'}$$

Assuming $\frac{dM}{d\bar{P}} \geq 0$, it follows that $B' > 0$ and $\frac{dP_m}{dP_0} < 0$. We can rewrite A' as:

$EA' = (1-q)\, E^P \frac{D_U^P}{P_0} - qE^R \frac{D_U^R}{P_m} = \frac{D_U^R}{M} E^P \frac{D_U^P}{P_0} - \frac{D_U^P}{M} E^R \frac{D_U^R}{P_m} = \frac{D_U^R D_U^P}{M} \left(\frac{E^P}{P_0} - \frac{E^R}{P_m}\right)$, where

= price elasticity of demand of group J. Since $P_m = P_0$, it follows that if the price elasticity of demand of the urban poor is larger than that of the urban rich, then $A' < 0$ and $\frac{d\bar{P}}{dP_0} < 0$. In the case of India, Radhakrishna, Murthy and Shah have found that $|E^P| = 0.8 > |E^R| = 0.4$, so that

$$\frac{d\bar{P}}{dP_0} < 0.$$

Thus, starting from a situation of no procurement policy ($P_o = P_m$), a "small" (infinitesimal) application of that policy (i.e., a "small" reduction in P_o) will result in an increase in P_m and $\bar{P}$ as long as the price elasticity of marketed surplus is non-negative and the demand of the urban rich is less elastic than the demand of the urban poor. In this case, the policy leads to a price discrimination which is beneficial to the farmers as a whole. Net buyers in the rural area (small farmers and landless laborers) lose in the short run, while the long-run impact depends on the effect of the average producer price increase on rural employment opportunities and wages. Rich urban consumers lose and poor urban consumers gain. As is known from the theory of discriminating monopoly, a necessary condition for producers as a whole to gain is that those consumers who are charged the higher price (the rich) have a less elastic demand.

We now state

Proposition 2. In the case of a closed economy and no rationing, the impact on P_m and $\bar{P}$ is ambiguous in general. However, starting from $P_m = P_0$ (no policy), a "small" application

of the policy will raise P_m and $\bar{P}$ if the elasticity of the marketable surplus is non-negative and the demand of the urban poor is more elastic than the demand of the urban rich. In the latter case, farmers as a whole gain, the urban poor gain and the urban rich lose. Net rural buyers (small farmers and landless labor) lose in the short run, while the long-term effect is ambiguous.

The result $d\bar{P}/dP_0 < 0$ (which is essentially the result claimed by Dantwala and by Hayami, Otsuka and Subbarao) only holds locally, i.e., around $P_m = P_0$, but it is ambiguous in the more general and interesting case where P_m is larger than P_0 or where the change in P_0 is "large" (e.g., in the case of food shortages), unless further restrictions are imposed.

For instance, assume the demand of the urban rich is inelastic and that of the urban poor is elastic, and the marketed surplus is constant. Then any reduction in P-ZERO will raise producer revenue both because of the larger sales to the poor at the lower ration-shop price P-ZERO (elastic demand) and from lower sales to the rich at the higher price P-M (inelastic demand). Thus, revenue rises in both markets. Since total revenue rises and marketed surplus is given, P-BAR must increase. The same result obtains if one of the two demand curves has an elasticity equal to one. However, note that Radhakrishna, Murthy and Shah found an elasticity for the poor smaller than one (0.8). In that case, revenue from selling to the poor falls as the price falls. Thus, the impact on P-BAR is ambiguous for discrete applications of the policy when the parameter values which have been reported for India are used.

What is the explanation for the fact that the impact on the average price P-BAR is unambiguously positive in Case 2 when the policy is applied infinitesimally but not for a discrete application of the policy? Let us start by assuming that the marketed surplus is given and does not vary with price (this assumption is relaxed below). Then, any increase in the consumption of the urban poor with access to the ration shops is matched by an equal decrease in consumption by the

rich. Since the price elasticity of the rich is smaller than for the poor, marginal revenue is larger for the poor than for the rich. Then, revenues are maximized by shifting consumption from the rich to the poor until marginal revenues are equalized in both markets.

Thus, a small application of the procurement policy will increase total revenue and also the average price. However, a discrete application of the policy has an ambiguous effect because it might lead to a shift in consumption which is larger than the shift which maximizes revenues (so that the marginal revenue for the rich becomes larger than for the poor). This might result in lower revenues and a lower average price.

The fact that the marketed surplus increases with the average price cannot reverse these results. Assume the average price increases for a given marketed surplus. The higher average price leads to an increase in marketed surplus. This lowers the average price. However, the new equilibrium average price cannot be lower than in the absence of the policy since a lower average price would result in a lower - not larger - marketed surplus. Thus, a positive slope of the marketed surplus will dampen the effect of the procurement policy on the average price but will not reverse it.

Case 3. Closed Economy, Rationing and Market Segmentation

In this case, the poor's demand D_U^P exceeds the supply provided by the ration shops. Hence, D_U^P depends on P_m, the price of the marginal units, rather than on P_o, and depends not on Y^P but on $y_p = Y^P + V$ which includes the value V of having access to the rationed units at the lower price. The value V depends on how the rationed units are distributed. If no more ration cards are distributed to the target population of urban poor than the supply available at the ration shops, then there will be no queuing and $V = (P_m - P_o)Q_o$, where Q_o is the procured and rationed output. If more ration cards are distributed than the supply available at the ration shops (i. e., the rationed demand exceeds the available supply), it will result in queues, and the value of the time waiting in line must be subtracted. The length of the line depends on the number of ration cards relative to the

available supply. However, the full cost of obtaining a unit of the product at the ration shop - including the value of waiting time - cannot be larger than the open market cost P_m. The reason for that is arbitrage, as the poor always have the choice to buy at the open market at the price P_m. That determines the maximum length of the queue where the full cost of buying the product is the same in both markets and $V = 0$ (and $y_p = Y^P$). We start by assuming no queuing, then examine the case of queuing.

In the absence of queuing, equation (3) becomes:

$$(4) \qquad M = S(\bar{P}) - D_F\left[\bar{P}, \pi(\bar{P})\right] = D_U^P(P_m, y_p) + D_U^R(P_m, Y^R),$$

where $\bar{P} = qP_0 + (1-q)P_m$,

q = proportion of marketed surplus which is procured

$= \frac{Q_0}{M}$ $(Q_0 < D_U^P)$, and

$y_p = Y^P + (P_m - P_0)\,qM = Y^P + (P_m - P_0)\,Q_0$ is the total income of the urban poor (inclusive of the value V of the right of access to the rationed output Q_0 at the low price P_0).

The signs of both $\frac{d\bar{P}}{dP_0}$ and $\frac{dP_m}{dP_0}$ are ambiguous. If $\frac{dM}{d\bar{P}} = 0$, then $\frac{dP_m}{dP_0} < 0$ but the sign of $\frac{d\bar{P}}{dP_0}$ remains ambiguous. In this case, the urban rich lose while

the urban poor may gain or lose (depending, for the case where $\bar{P}$ rises, on the share they purchase on the open market at the higher price P_m).9/

In the case of queuing, the longer the queue, the lower the income gain V to the urban poor. At the limit, V equals zero ($y_p = Y^P$). Then, as shown in Appendix B, equations B.5 and B.6, $dP_m/dP_0 \leq 0$ as long as $dM/d\bar{P} \geq 0$ or $\leq \frac{dD_U}{dP_m}/(1-q)$, and $d\bar{P}/dP_0 > 0$ as long as $dM/d\bar{P} > (dD_U/dP_m)/(1-q)$. Thus, with a positive elasticity of marketable surplus, procurement will necessarily lead to a rise in P_m and to a fall in $\bar{P}$. This is the worst scenario as all three groups (urban rich, urban poor and farmers as a whole) lose. Even if the elasticity of marketable surplus is negative, procurement can still lead to a fall in the average price received by farmers. And if $dM/d\bar{P} = 0$, then P_m remains unchanged and $d\bar{P}/dP_0 = q$, i.e., $\bar{P}$ falls by a proportion q of the fall in P_0.

We now state

Proposition 3. In the case of a closed economy, rationing and market segmentation, if rationing is done without queuing, the impact on P_m and $\bar{P}$ is ambiguous in general. If rationing is done by queuing, P_m will rise and $\bar{P}$ will fall if the price elasticity of marketable surplus is positive (a sufficient but not necessary condition) and the queue is long (so that the full cost of buying at the ration shop approximates the open market price). Then, the farm sector and all urban consumers lose. Small farmers and landless laborers gain in the short run, while the long-run impact is ambiguous.

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9. If the average price $\bar{P}$ remains unchanged or falls, then since the urban rich pay $P_m > \bar{P}$, the urban poor pay on average less than $\bar{P}$ and therefore must gain. However, if $\bar{P}$ rises, the urban poor may gain or lose.

Case 4. Closed Economy, Rationing and No Market Segmentation

In this case, we only have to consider total urban demand D_U. Assume rationing is done in the absence of queuing. Then, equations (B.3) and (B.4) become respectively:

$$(5) \qquad \frac{dP_m}{dP_0} = \frac{\frac{dM}{d\bar{P}} q\left[1-(P_m-P_0)\frac{dD_U}{dy}q\right] + \frac{dD_U}{dy} qM}{\frac{dD_U}{dP_m} + \frac{dD_U}{dy} qM + (1-q)\left[(P_m-P_0)\frac{dD_U}{dy} q-1\right]\frac{dM}{d\bar{P}}} = \frac{A_1}{B_1},$$

and

$$(6) \qquad \frac{d\bar{P}}{dP_0} = \frac{q\left(\frac{dD_U}{dP_m} + \frac{dD_U}{dy}M\right)}{B_1} = \frac{C_1}{B_1},$$

where y = urban income, including the value to the urban consumers of having access to qM units at price P_0.

If $\frac{dM}{d\bar{P}} \geq 0$, then $\frac{dP_m}{dP_0} < 0$ and $\frac{d\bar{P}}{dP_0} > 0$ as we show below. Let us first look at C_1. Since $M = D_U$, the term in parenthesis is simply the compensated price effect, and thus $C_1 < 0$. Second, the sum of the first two terms of B_1 is negative since

$\frac{dD_U}{dP_m} + \frac{dD_U}{dy} qM < \frac{dD_U}{dP_m} + \frac{dD_U}{dy} M < 0$. Thus, if $\frac{dM}{d\bar{P}} = 0$, then $A_1 > 0$, $B_1 < 0$, $\frac{dP_m}{dP_0} < 0$ and since $C_1 < 0$, $\frac{d\bar{P}}{dP_0} > 0$.

This result also holds for $\frac{dM}{d\bar{P}} > 0$. Let us first examine the term $F = (P_m - P_0)\frac{dD_U}{dy} q-1$. This can be rewritten as

$$(7)\quad F = (P_m - P_0)\frac{dD_U}{dy}\frac{Q_0}{M} - 1 = (P_m - P_0)\frac{dD_U}{dy}\frac{Q_0}{D_U} - 1 = \frac{(P_m - P_0)Q_0}{y}E_U^Y - 1,$$

where E_U^Y is the income elasticity of demand for the urban consumers.

For F to be negative or zero, it must be the case that

$$E_U^Y \leq \frac{y}{(P_m - P_0)Q_0} = \frac{Y + (P_m - P_0)Q_0}{(P_m - P_0)Q_0} = 1 + \frac{Y}{(P_m - P_0)Q_0}.$$

Now Y is total urban income, and is several times larger than $(P_m - P_0)Q_0$, the value of the property right to the Q_0 rationed units. Thus, E_U^Y could be several times larger than 1 and we would still have $F \leq 0$.

For India, NCAER and Pandey report income elasticities, respectively, of .489 and .71 for foodgrains, and of .616 and .79 for all cereals. Pandey reports an income elasticity for rice of 1.06. The GOL (Grain, Oilseeds and Livestock) study of the USDA reports income elasticities of 0.70 for rice and 0.70 for wheat. These results imply that $F < 0$.

Since the sum of the first two terms of B_1 is negative, if $F \leq 0$ and $\frac{dM}{d\bar{P}} \geq 0$, then B_1 is negative. Since $C_1 < 0$, $\frac{d\bar{P}}{dP_0} > 0$. Also, $A_1 = \frac{dM}{d\bar{P}}q(-F) + \frac{dD_U}{dy}qM > 0$, and thus $\frac{dP_m}{dP_0} < 0$.

Thus, if the policy does not differentiate between urban rich and poor, and if $\frac{dM}{d\bar{P}} \geq 0$, then the procurement policy, which implies a reduction in P_0, will lead to an increase in the open market price P_m, but will lead to a decrease in the average price $\bar{P}$ received by farmers. Under these circumstances, farmers lose on average and consumers gain on average. If the income elasticity of demand for the procured products is zero and if the urban rich have the same access to the ration

shops as the urban poor, then both urban rich and poor will buy the same proportion at price P_0 and at price P_m, i.e., on average they will both pay $\bar{P}$. Hence, they will both gain. If, as has been found, the income elasticity for these products in urban areas of developing countries is positive, the rich will buy a larger share at P_m than the poor. Hence, the poor will gain and the rich may or may not gain.

The fall in $\bar{P}$ holds even more strongly if rationing is done by queuing, and can hold even for a negative elasticity of marketed surplus (see equation B.6 in Appendix B). Thus, farmers as a whole also lose in this case. At the limit, $V = 0$. Then, all consumers pay P_m once the cost of waiting is taken into account, so that both the urban poor and the urban rich lose. Hence, every group loses from the procurement policy in this case.

We now state

Proposition 4. In the case of a closed economy, rationing and no market segmentation, P_m rises and $\bar{P}$ falls if the price elasticity of the marketable surplus is non-negative. This is true whether rationing occurs with or without queuing. In the absence of queuing, the urban poor gain and the urban rich may gain or lose. With long queues, all urban consumers lose. Farmers lose as a whole. However, the net buyers (small farmers, landless labor) gain in the short run while the long-run effect is ambiguous.

India's public distribution system has been described as one where ration cards are distributed to urban poor as well as rich, and where buyers at ration shops have to queue. The value of the time spent queuing must be subtracted from the income gain obtained because of the access to food at price P_0 rather than P_m. Our analysis indicates that this should lead to a fall in the average price paid to

farmers as long as the price elasticity of the marketable surplus is non-negative (see Southwestern corner of Table 1).

The same result is obtained by Binswanger and Quizon. They use a general equilibrium model of the Indian economy to simulate alternative price policies. In the case of forced procurement and equal access by all urban groups to the ration shops, they find that the impact on $\bar{P}$ is negative. Sah and Srinivasan find that the market price increases with a small amount of procurement in a model with rationing and no market segmentation. The impact on the average price is not reported.

III. Summary and Conclusions

We examined the effect of the procurement policy on the open market price P_m and on the average price $\bar{P}$ received by farmers under various circumstances, and analyzed the impact on the urban rich, the urban poor and the farmers. The effects on prices are summarized in Table 1.

India's trade liberalization process has mainly affected industry so far, but the case for free trade in agricultural products is being debated by the government. In the case of free trade, P_m is unaffected by the policy and $\bar{P}$ falls, irrespective of whether or not the procured output is rationed and targeted to the poor. Farmers as a whole lose, the urban poor gain and the urban rich gain if they have access to the procured output. These results are weakened if the range between the CIF and the FOB price is large.

In the closed-economy case, if the urban poor can satisfy their demand at P_0 (no rationing), the effect of the policy on P_m and $\bar{P}$ is generally ambiguous. However, starting from $P_m = P_0$ (no procurement policy), and if marketed surplus M increases with $\bar{P}$, then a "small" application of that policy will lead to an increase in P_m and $\bar{P}$ as long as the demand of the urban rich is less price elastic than the demand of the urban poor. Farmers as a whole and the urban poor gain, while the urban rich lose. In the short run, the rural poor (small farmers who are net buyers and landless labor) lose if they pay P-BAR on average but might gain if they buy mostly at the ration shops and queues are short. In the long-run, the effect depends also on the impact of the higher average price on rural employment and wages.

In the closed-economy case, if the urban poor cannot satisfy their entire demand at P_0, and the rationing is by ration cards in the absence of queuing, the effect of the policy on P_m and $\bar{P}$ is ambiguous, unless the policy does not differentiate between the urban poor and rich (or unless the

rich do not consume that product) and $\frac{dM}{d\bar{P}} \geq 0$. Then, the policy will lead to an increase in P_m and to a decrease in $\bar{P}$. Farmers as a whole lose, the rural poor gain in the short run, the urban poor gain and the urban rich may gain or lose. If rationing is by queuing and the queue is long, then the policy will result in an increase in P_m if $dM/d\bar{P} > 0$ and to a fall in $\bar{P}$ even if $dM/d\bar{P} < 0$. All groups lose in this case.

As long as the policy is not applied infinitesimally, there is no indication that it will lead to the increase in $\bar{P}$ predicted by Dantwala and Hayami, Subbarao and Otsuka. The effect on $\bar{P}$ is ambiguous or negative, except in the case of (a) a closed economy with (b) no rationing to the urban poor, (c) perfect market segmentation between urban rich and poor, (d) marketable surplus does not fall with price, (e) the price elasticity of demand for the urban poor is larger than for the rich, and (f) the procurement policy is applied infinitesimally. Only under those conditions is the effect on $\bar{P}$ unambiguously positive, though it is very small.

It is interesting to note that Hayami, Subbarao and Otsuka assume conditions (b) and (c) to hold in their analysis while at the same time stating that India's distribution system results in long queues and is unable to differentiate between urban rich and poor (page 655). If their description of the operation of the policy is correct, then our analysis indicates that procurement will lead to a decrease in $\bar{P}$ (Southwest corner of Table 1). Thus, a policy which was designed to help the urban poor may very well have hurt the farm sector as a whole, though it may have helped the rural poor in the short run.

We have implicitly assumed that transaction costs are the same in the private and public distribution systems by setting producer prices equal to consumer prices. However, it seems plausible to assume higher costs for the public distribution system. In a recent World Bank study on India's agricultural policies, Sharma found in the case of wheat that the cost of public distribution was twice

as high as the cost of private distribution. If so, then the probability that the average price paid to farmers rises with the procurement policy is even lower. Moreover, the consumer benefits associated with the procurement policy also fall in this case. The opposite is true if explicit budgetary funds are provided to finance the policy.

This paper has shown that under reasonable assumptions the impact of the policy has been a fall in the average producer price. Thus, a policy which was designed to help the urban poor most probably hurt the farm sector as a whole, though it probably helped the rural poor in the short run.

Table 1. Impact of Procurement Policy (i.e., setting the procurement price P_0 below the open-market price P_m) on P_m and on the average price $\bar{P}$

		NO TRADE[a]			FREE TRADE
		$dM/d\bar{P} > 0$	$dM/d\bar{P} = 0$	$dM/d\bar{P} < 0$	
No Rationing	Segmented Market between Rich and Poor[b]	P_m and $\bar{P}$ may rise or fall, unless $P_m = P_0$ in which case $\frac{dP_m}{dP_0} < 0, \frac{d\bar{P}}{dP_0} < 0$ [c]	P_m increases, $\bar{P}$ may rise or fall, unless $P_m = P_0$ in which case $\frac{d\bar{P}}{dP_0} < 0$ [c]	P_m and $\bar{P}$ may rise or fall	P_m unchanged $\bar{P}$ falls
Rationing	Segmented Market between Rich and Poor	No Queuing P_m and $\bar{P}$ may rise or fall Queuing: P_m rises, $\bar{P}$ falls	No Queuing P_m increases $\bar{P}$ may rise or fall Queuing: P_m unchanged, $\bar{P}$ falls	No Queuing P_m and $\bar{P}$ may rise or fall Queuing: P_m may rise or fall, $\bar{P}$ falls[d]	P_m unchanged $\bar{P}$ falls
	Unsegmented Market	No Queuing P_m increases $\bar{P}$ falls[d] Queuing: P_m rises, $\bar{P}$ falls.	No Queuing P_m increases $\bar{P}$ falls Queuing: P_m unchanged, $\bar{P}$ falls	No Queuing P_m and $\bar{P}$ may rise or fall Queuing: P_m may rise or fall, $\bar{P}$ falls[d]	P_m unchanged $\bar{P}$ falls

Table 1 - cont'd

a/ The results of the case of "No Trade" also hold if trade is controlled by the government and is independent of price.

b/ The case of "Segmented Market between Rich and Poor" means that the rich will have no access to the rationed units at price P_0, but the poor do have access to the units sold in the open market at price P_m. There can be no case of "No Rationing" and "Unsegmented Market" because in that case all consumers buy at P_0 resulting in excess demand which must be rationed (unless $dM/d\bar{P}$ is so negative that farmers exactly release the increase in urban demand, but that raises problems of multiple equilibria and stability).

c/ This holds only for a "small" reduction in P_0, and if $|E^P| > |E^R|$ where E^j = price elasticity of demand of group j (j = P (poor), R (rich)). Available evidence on India indicates that $|E^P| > |E^R|$.

d/ This holds if $E_U^Y \leq 1 + \frac{Y}{(P_m - P_0)Q_0}$, where E_U^Y = income elasticity of demand of urban consumers, Y = urban income, and $(P_m - P_0)Q_0$ = the value of the property rights to the rationed units Q_0. Evidence indicates that this condition is easily satisfied.

e/ $\bar{P}$ falls as long as $dM/d\bar{P} > (dD_U/dP_M)/(1-q)$.

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Appendix A.

From equation (3):

$$\frac{dM}{dP_0} = \frac{dD_U^P}{dP_0} + \frac{dD_U^R}{dP_0},$$

or

$$\text{(A.1)} \qquad \frac{dM}{d\bar{P}} \frac{d\bar{P}}{dP_0} = \frac{dD_U^P}{dP_0} + \frac{dD_U^R}{dP_m} \frac{dP_m}{dP_0}.$$

Using the definition of $\bar{P}$, we have:

$$\text{(A.2)} \qquad \frac{d\bar{P}}{dP_0} = q + (1-q)\frac{dP_m}{dP_0} + \frac{dq}{dP_0}(P_0 - P_m), \quad 10/$$

and from (A.1) and (A.2), we obtain:

$$\frac{dM}{d\bar{P}}\left[q + (1-q)\frac{dP_m}{dP_0} + \frac{dq}{dP_0}(P_0 - P_m)\right] = \frac{dD_U^P}{dP_0} + \frac{dD_U^R}{dP_m}\frac{dP_m}{dP_0}$$

or

$$\text{(A.3)} \qquad \frac{dP_m}{dP_0} = \frac{\dfrac{dD_U^P}{dP_0} - \left[q + \dfrac{dq}{dP_0}(P_0 - P_m)\right]\dfrac{dM}{d\bar{P}}}{(1-q)\dfrac{dM}{d\bar{P}} - \dfrac{dD_U^R}{dP_m}}.$$

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10. In the case of no rationing, q cannot be determined by the government independently of the level of P_0 since the entire demand of the urban poor D_U^P must be satisfied at the price P_0.

The sign of $\frac{dP_m}{dP_0}$ cannot be examined until we have solved for $\frac{d\bar{P}}{dP_0}$ because $\frac{dq}{dP_0} = \frac{d(D_U^P/M)}{dP_0}$ depends on it.

From (A.2) and (A.3), we obtain:

$$\frac{d\bar{P}}{dP_0} = q + (1-q)\frac{\frac{dD_U^P}{dP_0} - \left[q + \frac{dq}{dP_0}(P_0 - P_m)\right]\frac{dM}{d\bar{P}}}{(1-q)\frac{dM}{d\bar{P}} - \frac{dD_U^R}{dP_m}} + \frac{dq}{dP_0}(P_0 - P_m),$$

or

$$\frac{d\bar{P}}{dP_0} = \frac{(1-q)\frac{dD_U^P}{dP_0} - \left[q + \frac{dq}{dP_0}(P_0 - P_m)\right]\frac{dD_U^R}{dP_m}}{(1-q)\frac{dM}{d\bar{P}} - \frac{dD_U^R}{dP_m}}. \tag{A.4}$$

Since $q = D_U^P/M$, we have:

$$\frac{dq}{dP_0} = \frac{\frac{dD_U^P}{dP_0}M - D_U^P\frac{dM}{dP_0}}{M^2} = \frac{\frac{dD_U^P}{dP_0}M - D_U^P\frac{dM}{d\bar{P}}\frac{d\bar{P}}{dP_0}}{M^2}. \tag{A.5}$$

From (A.4) and (A.5), we obtain:

$$\frac{d\bar{P}}{dP_0} = \frac{(1-q)\frac{dD_U^P}{dP_0} + \left[\frac{(P_m - P_0)}{M}\frac{dD_U^P}{dP_0} - q\right]\frac{dD_U^R}{dP_m}}{(1-q)\frac{dM}{d\bar{P}} - \frac{dD_U^R}{dP_m} - \frac{D_U^P}{M^2}\frac{dM}{d\bar{P}}(P_0 - P_m)\frac{dD_U^R}{dP_m}} = \frac{A}{B} \gtrless 0. \tag{A.6}$$

Appendix B.

From equation (7):

$$\frac{dM}{dP_0} = \frac{dD_U^P}{dP_0} + \frac{dD_U^R}{dP_0},$$

or

$$\frac{dM}{d\bar{P}}\frac{d\bar{P}}{dP_0} = \frac{dD_U^P}{dP_m}\frac{dP_m}{dP_c} + \frac{dD_U^P}{dy_p}\frac{dy_p}{dP_0} + \frac{dD_U^R}{dP_m}\frac{dP_m}{dP_0}$$

or

$$\frac{dM}{d\bar{P}}\frac{d\bar{P}}{dP_0} = \frac{dD_U}{dP_m}\frac{dP_m}{dP_0} + \frac{dD_U^P}{dy_p}q\left[\left(\frac{dP_m}{dP_0}-1\right)M + (P_m - P_0)\frac{dM}{d\bar{P}}\frac{d\bar{P}}{dP_0}\right],$$

where

$$D_U = D_U^P + D_U^R.$$

Thus:

$$\frac{dM}{d\bar{P}}\frac{d\bar{P}}{dP_0}\left[1-(P_m - P_0)\frac{dD_U^P}{dy_p}q\right] = \frac{dD_U}{dP_m}\frac{dP_m}{dP_0} + \frac{dD_U^P}{dy_p}q\left(\frac{dP_m}{dP_0}-1\right)M. \tag{B.1}$$

In the case of rationing, q can be determined independently of P_0. We assume here that q is given and examine the effect of a change in P_0. Then:

$$\frac{d\bar{P}}{dP_0} = q + (1-q)\frac{dP_m}{dP_0}. \tag{B.2}$$

From (B.1) and (B.2), we obtain:

$$\frac{dM}{d\bar{P}}\left[q+(1-q)\frac{dP_m}{dP_0}\right]\left[1-(P_m-P_0)\frac{dD_U^P}{dy_p}q\right]=\frac{dD_U}{dP_m}\frac{dP_m}{dP_0}+\frac{dD_U^P}{dy_p}q\left(\frac{dP_m}{dP_0}-1\right)M,$$

or

$$\text{(B.3)}\qquad \frac{dP_m}{dP_0}=\frac{\frac{dM}{d\bar{P}}q\left[1-(P_m-P_0)\frac{dD_U^P}{dy_p}q\right]+\frac{dD_U^P}{dy_p}qM}{\frac{dD_U}{dP_m}+\frac{dD_U^P}{dy_p}qM+(1-q)\left[(P_m-P_0)\frac{dD_U^P}{dy_p}q-1\right]\frac{dM}{d\bar{P}}}=\frac{A_0}{B_0}\gtrless 0.$$

From (B.2) and (B.3), we obtain:

$$\text{(B.4)}\qquad \frac{d\bar{P}}{dP_0}=\frac{q\left(\frac{dD_U}{dP_m}+\frac{dD_U^P}{dy_p}M\right)}{B_0}=\frac{C_0}{B_0}\gtrless 0.$$

In the case of rationing by queuing, $V = 0$ and $y_p = Y^P$. Then, equations (B.3) and (B.4) become:

$$\text{(B.5)}\qquad \frac{dP_m}{dP_0}=\frac{(dM/d\bar{P})q}{\frac{dD_u}{dP_m}-(1-q)\frac{dM}{d\bar{P}}}<0 \text{ if } \frac{dM}{d\bar{P}}>0 \text{ or if } \frac{dM}{d\bar{P}}<\frac{dD_u}{dP_m}/(1-q),$$

and

$$\text{(B.6)}\qquad \frac{d\bar{P}}{dP_0}=\frac{q\frac{dD_u}{dP_m}}{\frac{dD_u}{dP_m}-(1-q)\frac{dM}{d\bar{P}}}>0 \text{ if } \frac{dM}{d\bar{P}}>\frac{dD_u}{dP_m}/(1-q). \quad \text{If} \quad \frac{dM}{d\bar{P}}=0, \text{ then } \frac{d\bar{P}}{dP_0}=q.$$

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